

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 April 2003 (17.04.2003)

PCT

(10) International Publication Number
WO 03/030744 A1

(51) International Patent Classification⁷: **A61B 17/11**

(21) International Application Number: **PCT/GB01/04484**

(22) International Filing Date: 9 October 2001 (09.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **JOMED NV** [NL/NL]; Bamfordweg 1, NL-6235 NS Ulestraten (NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DICKINSON, Robert** [GB/GB]; 51 West Hill Road, Wandsworth, London SW18 1LE (GB). **ERIKSSON, Joackim** [SE/SE]; Hoeganaesv 62 CS, S-260 40 Viken (SE). **ROTHMAN, Martin, Terry** [GB/GB]; 81 Anchorage Point, Cuba Street, London E14 8NF (GB).

(74) Agent: **BURRINGTON, Alan, Graham, Headford**; Atkinson Burrington, 25-29 President Buildings, President Way, Sheffield S4 7UR (GB).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

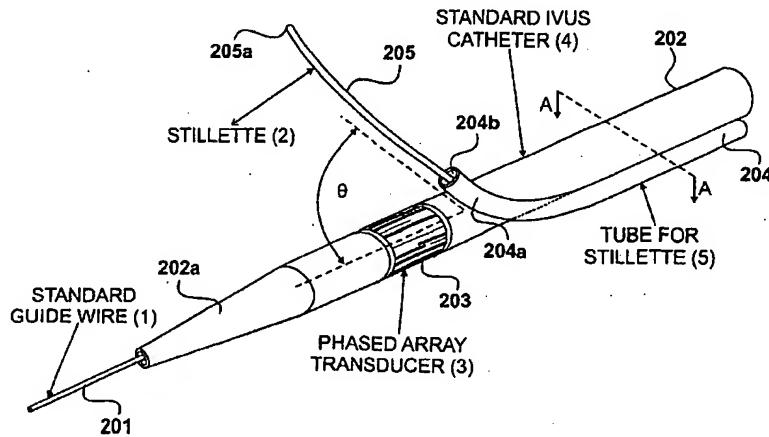
(84) Designated States (regional): ARIPo patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CORONARY BYPASS APPARATUS AND METHOD



WO 03/030744 A1

(57) Abstract: Apparatus for minimally invasively bypassing a body lumen, the apparatus comprising: a catheter having proximal and distal regions; an imaging transducer coupled to the distal region; and a cutting element adapted to form an opening in the body lumen, said cutting element coupled to the distal region, wherein the imaging transducer is adapted to enable a clinician to position said cutting element.

BEST AVAILABLE COPY

Coronary Bypass Apparatus And Method

Background of the Invention

The present invention relates to a coronary bypass apparatus and
5 method.

Coronary artery disease is a significant medical problem in the developed world and treatments include pharmaceutical therapies, surgical intervention and percutaneous angioplasty.

Surgical intervention uses a vessel harvested from the patient
10 themselves and grafted onto the blocked coronary artery to bypass the obstruction. This is termed Coronary Artery Bypass Grafting (CABG). Usually this is a significant operation which involves opening up the chest cavity.

Percutaneous techniques use coronary catheters to open up the obstruction and require the catheter to cross through the obstruction. Such
15 techniques are significantly less traumatic from the patient's point of view.

Description of the Related Art

The present invention is concerned with minimally invasive methods of performing CABG, which methods do not require such a major surgical
20 operation as that discussed above.

One known technique takes advantage of the fact that many coronary arteries have a vein running parallel to the artery. An example is The Left Anterior Descending Coronary artery which has the Great Cardiac Vein in its vicinity.

This known technique diverts arterial blood into the vein by creating a conduit between the two in order to bypass the arterial blockage. Blood passing through the conduit either returns into the artery beyond the
25

blockage or through the vein perfuses the muscle with oxygenated blood. The return of the blood, the so-called venous return, is then via other routes. The advantage of this technique is that it can be performed percutaneously using catheters.

5 Examples of this known technique are disclosed in United States Patent Nos. 5,830,222 and 6,068,638.

10 This prior art technique requires a separate ultrasound imaging catheter to enable the puncture to be made in the correct direction, namely towards the neighbouring vessel. In addition the vein which is proximal to the conduit is blocked with a suitable plug in order to divert the high-pressure arterial blood into the distal region.

Brief Summary of the Invention

15 The present invention is concerned with providing an improved apparatus and method for bypassing a coronary blockage utilising the patient's adjacent vein as a bypass to that blockage.

20 According to the present invention apparatus of the kind previously described for effecting an artery bypass utilising an adjacent vein is combined with imaging transducer in order to enable a clinician to accurately position the means for creating a conduit between the artery and the adjacent vein.

The apparatus preferably comprises a catheter with an imaging transducer. The imaging transducer may comprise, for example, an intravascular ultrasonic (IVUS) imaging transducer, a phased array IVUS transducer, a rotational or mechanical IVUS transducer, an Optical Coherence Tomography (OCT) transducer, or a Magnetic Resonance Imaging (MRI) transducer.

25 Where the imaging means comprises an imaging catheter the above

referred to combination could take a number of forms.

Firstly it could be achieved by having two separate catheters which are used one after the other. The first catheter carrying the ultrasonic transducer array at or near its distal end would be used to make the incision 5 in the wall of the artery and then the incision in the wall of the adjacent vein and the second catheter would then be used subsequently to create the conduit between the artery and the adjacent vein.

More particularly, the first catheter would incorporate a stilette (a wire with a pointed distal end) in order to pierce the wall of the artery and then the 10 wall of the adjacent vein.

The second catheter would incorporate means for enlarging the incision made in the walls of the artery and adjacent vein and would incorporate a stent which could then be delivered to the expanded apertures in the artery and the vein in order to create the conduit between the artery 15 and the vein.

Secondly it could be achieved by having a single catheter which combines the features of the two catheters referred to immediately above.

Brief Description of the Several Views of the Drawings

20 How the invention may be carried out will now be described by way of example only and with reference to the accompanying drawing in which:

Figure 1 illustrates a coronary bypass procedure using an adjacent vein;

25 *Figure 2* is a perspective view showing the distal end of a first catheter incorporating an imaging transducer;

Figure 3 is a partial cross-sectional view taken along the line A-A in *Figure 2*;

Figure 4 is a diagrammatic representation of the image of the catheter in use;

Figure 5 illustrates the use of the imaging catheter for making the incision in the artery and vein walls; and

5 *Figure 6* is a view similar to *Figure 4* and illustrating the endpoint of the second stage of the procedure employing the second type of catheter.

Best Mode for Carrying Out the Invention

10 A patient has a blockage 100 within a coronary artery 101 alongside which runs an existing vein 102.

In order to bypass blockage 100 a first passage 103 is formed between the artery 101 and the vein 102 so that blood flowing in the artery 101 (as indicated by the arrows) can pass through the passage 103 and into the vein 102.

15 This blood may then either be allowed to continue its flow through the vein 102 to perfuse the heart muscle with oxygenated blood, the venous return being via other routes within the patient's body, or the blood flow may pass through a second passage 104 formed between the vein 102 and the artery 101 in order to then continue its flow through the vein 101 having 20 bypassed the obstruction 100.

This general technique is already known, the present invention being concerned with an apparatus and method for forming the passage 103.

Essentially this apparatus and method involve the employment of two different and separate catheters that can be introduced into the patient's 25 vascular system typically through an incision made in an artery in the patient's groin. This provides a method which is minimally invasive when compared with the major surgery required in carrying out Coronary Artery

Bypass Grafting (CABG).

The first step in this minimally invasive method is to insert into the patient's vascular system, and in particular the artery 101, a standard guide wire 201 in the well-known way. The distal end of the guide wire 201 is positioned upstream of the blockage 100 in the vicinity of the location where it is desired to form the first conduit 103.

5 The first catheter 202 is then slid down the guide wire 201 in known manner.

10 The first catheter 202 is an imaging catheter which has near its distal end 202a a imaging transducer 203. As this kind of intravascular ultrasonic catheter is already known it will not be described in any more detail.

15 Mounted on this intravascular imaging catheter 202 is a tube 204 which runs substantially the length of the catheter and through which a metal stillette 205 may be threaded. The stillette is a metal wire with a pointed distal end.

Thus one aspect of the present invention is the combination of the tube 204 mounted on the outside of an imaging catheter 202.

20 The way in which this first catheter is employed will now be described with reference to *Figures 3 - 5* in which the same reference numerals have been used to designate those same items which appear in *Figures 1 and 2*.

It will be seen in *Figure 2* that the distal end of the tube 204 is at an angle to the axis of the body of the ultrasound catheter 202 whereas the main part of the tube 204 runs parallel to that axis. This angle to the axis of the catheter 202 is indicated at θ in *Figure 2*.

25 The purpose of the angling of the distal end 204a of the tube 204 with respect to the axis of the catheter 202 is to enable the distal end of the stillette 205 to traverse the path indicated in *Figure 5*. A marker 401 can be

put on the image illustrated in *Figure 4* to indicate the intended route for the distal end of the stillette 205 in order to ensure that it pierces the arterial wall 101 and vein wall 102 at the correct locations.

5 The catheter 202 is rotated so that the opening 204b of the distal end of the tube 204 is pointing at the desired target area of the arterial wall 101 and the marker 401 aligns with both the artery 101 and the vein 102, the stillette 205 being aligned for the proper formation of the passage 103.

10 The stillette 205 which comprises a wire with a sharp tip 205a is then pushed down the tube 204 so that the tip 205a enters the arterial wall 101 and the marker 401 aligns with both the artery 101 and the vein 102, the stillette 205 being aligned for the proper formation of the passage 103. at the desired location of the first conduit 103.

15 Continued pushing of the stillette 205 results in the sharp tip 205a of the stillette passing through the matter 106 located between the artery 101 and the vein 102 and then piercing the wall 102b of the vein 102.

The distal tip 205a of the stillette 205 is in the imaging plane of the ultrasound array 203 thus enabling the correct position of the tip 205a to be confirmed from an examination of the image, as indicated in *Figure 4*.

20 Having positioned the distal tip 205a of the stillette 205 as indicated in *Figure 5* the first imaging catheter 202 can then be and is withdrawn from within the patient's artery by being pulled back along the guide wire 201 in the normal way.

25 The stillette wire 205 has to be rigid enough to puncture the artery wall 101b and the vein wall 102b but flexible enough to bend once the distal end 205a is within the lumen 102a of the vein 102, ie the pointed distal end 205a will not then continue and puncture the opposite wall of the vein 102.

These two competing requirements concerning the flexibility of the

distal end of the stillette 205 can be achieved in a number of ways.

One solution is to provide the stillette 205 with a rigid or semi-rigid tip 205a which could be about 3-4mm in length, there then being a flexible portion immediately adjacent the semi-rigid tip.

5 With this arrangement the flexible portion would be constrained within the delivery tube 204a, thus preventing it from bending, with only the semi-rigid tip protruding from the tube 204.

Once the semi-rigid tip has pierced the wall of the artery 101 and the wall of the vein 102 and as a result the flexible portion adjacent the semi-rigid tip is now outside the distal end 204a of the delivery tube 204 the distal end 10 of the stillette can bend within the lumen 102a of the vein 102 thus ensuring that there is no danger of the pointed end 205a of the stillette puncturing the far wall of the vein 102.

15 A second way of overcoming the problem referred to is to construct the stillette as a hypodermic tube as is well known to those skilled in the art.

After the hypodermic tube has penetrated into the lumen of the vein 102 a separate flexible guide wire is inserted through the inner lumen of the hypodermic tube, this guide wire being a standard guide wire and therefore flexible and not likely to penetrate the wall of the vein 102.

20 An advantage of using the second solution, namely the hypodermic tube, is that contrast liquid can be injected down the hypodermic tube so that once the tube enters the vein lumen 102a the contrast liquid will be seen on the fluoroscopy display to indicate that access from the lumen 101a of the artery 101 into the lumen 102a of the vein 102 has been achieved.

25 After the first imaging catheter 202 has been withdrawn from within the patient the stillette 205 is left within the patient's artery 101 with its proximal end outside the patient and accessible by the clinician and its distal end

located within the lumen of the patient's vein 102.

Thus the stillette 205 can then be used in effect as a guide wire for introducing the distal end of a second catheter into the conduit 103 formed between the patient's artery 101 and the patient's vein 102.

5 The essence of the second catheter is that it carries an expandable stent at or near its distal end so that the stent 601 can be delivered to its operative position as shown in *Figure 6*.

10 The stillette is used as a guide wire over which the stent catheter is advanced. However, the stent is delivered in a collapsed delivery configuration, and then expanded in place to an expanded deployed configuration, for example, with a balloon catheter, or through self-expansion. Thus, the second catheter preferably comprises a balloon catheter when a balloon-expandable stent is used, and a self-expandable stent delivery system when a self-expanding stent is used.

15 The stent acts as a conduit between the patient's artery 101 and the patient's vein 102. Additionally, or alternatively the stent may act as a plug or barrier within the lumen 102a of the vein 102 to prevent the flow of blood from the area B to the area C, or vice versa, as indicated in *Figure 6*.

20 The stent 601 may have a number of known constructions, these all essentially consisting of an expandable lattice or coiled spring-like structure whereby the stent can either have a retracted configuration when it is mounted on the delivery catheter (not shown) or is then capable of being expanded radially outwardly to form what is essentially a latticework tube as indicated in *Figure 6*.

25 Preferably the stent is also provided with a flexible cover (not shown) which would be essentially in the form of a tube coupled to the stent so that the stent will provide an effective lining to the conduit between the lumen of

the patient's artery 101 and the lumen of the patient's vein 102.

The delivery system for the stent could take a number of forms ie the catheter on which the stent is initially mounted could take a number of forms.

In one embodiment the catheter would be provided with a balloon
5 around which the unextended stent is mounted when the second catheter is first inserted into the patient's artery 101.

With this arrangement when the stent is in the target area as shown in
Figure 6 the balloon is expanded in the normal way typically by introducing
into it, from the proximal end of the catheter, a saline solution. Expansion of
10 the balloon converts the stent from its retracted to its expanded position as
shown in *Figure 6*. Optionally the stent would be provided with a protective
sheath to avoid its dislodgement as the distal end of the second catheter is
pushed along the patient's artery 101 to bring the stent into the target area
shown in *Figure 6*.

15 In another embodiment the stent is self-expandable and is mounted
on a sheath-based stent delivery system in known manner, such as the
JOSENT Self-X stent and delivery system marketed by JOMED NV of
Amsterdam, The Netherlands.

In order to avoid any risk of the stent being dislodged from its
20 operative position, as shown in *Figure 6*, the proximal end of the stent may
protrude into the coronary artery 101 by, for example, 0.5 mm, and this
protruding portion expanded so that the narrowest cross-section of the stent
is located between the patient's artery 101 and the patient's vein 102.

10

Claims

1. Apparatus for minimally invasively bypassing a body lumen, the apparatus comprising:

a catheter having proximal and distal regions;

5 am imaging transducer coupled to the distal region; and

a cutting element adapted to form an opening in the body lumen, said coupled element coupled to the distal region, wherein

the imaging transducer is adapted to enable a clinician to position said cutting element.

10

2. The apparatus of claim 1, wherein the cutting element comprises a tube coupled to the distal region of the catheter.

15

3. The apparatus of claim 2, wherein the cutting element further comprises a stillette adapted for passage through the tube, such that the stillette projects from the distal end of the tube.

20

4. The apparatus of claim 3 wherein the distal end of the tube is disposed substantially within an imaging plane of the imaging transducer.

5. The apparatus of claim 3, wherein a distal end of the stillette is at least semi-rigid.

25

6. The apparatus of claim 5, wherein a portion of the stillette adjacent its distal end is flexible.

7. The apparatus of claim 3, wherein a distal end of the stillette

comprises a hypodermic needle.

8. The apparatus of claim 1 further comprising an expandable stent coupled to the catheter.

5

9. The apparatus of claim 8, wherein the expandable stent comprises a stent chosen from the group consisting of a balloon-expandable stents, self-expanding stents, wire mesh stents, and bi-stable stents.

10

10. The apparatus of claim 8 further comprising an expander adapted to expand the stent.

15

11. The apparatus of claim 10, wherein the expander comprises an expander chosen from the group consisting of a balloon, and a self-expanding stent delivery system.

20

12. the apparatus of claim 1, wherein the imaging transducer is chosen from the group consisting of intravascular ultrasonic imaging transducers, phased array intravascular ultrasonic imaging transducers, rotational intravascular ultrasonic imaging transducers, mechanical intravascular ultrasonic imaging transducers, optical coherence tomography imaging transducers, and magnetic resonance imaging transducers.

25

13. A method for aligning an element of a catheter having an imaging transducer with a target site of a body lumen, the method comprising:

marking the radial position of the element relative to the imaging

transducer in images obtained from the imaging transducer; and
aligning the marking of the radial position with the target site in the
images obtained from the imaging transducer.

5 **14.** the method of claim 13, wherein the element comprises a
cutting element.

15. The method of claim 14 further comprising forming an opening
in the target site with the cutting element.

10

16. The method of claim 13, wherein aligning the marking
comprises rotating the catheter.

15

17. The method of claim 13, wherein aligning the marking
comprises advancing or retracting the catheter with respect to the target site.

20

18. The method of claim 13, wherein the imaging transducer is
chosen from the group consisting of intravascular ultrasonic imaging
transducers, phased array intravascular ultrasonic imaging transducers,
rotational intravascular ultrasonic imaging transducers, mechanical
intravascular ultrasonic imaging transducers, optical coherence tomography
imaging transducers, and magnetic resonance imaging transducers.

25

19. A method of detecting formation of a passage from a patient's
vein during minimally invasive bypass, the method comprising:
providing a hypodermic tube;
percutaneously advancing the tube to a target site within the patient's

artery;

injecting contrast medium through the tube;

advancing the tube through the target site into the patient's vein,
thereby forming a passage between the patient's vein;

5 and detecting the contrast agent within the patient's vein.

20. The method of claim 19, wherein detecting the contrast agent
comprises fluoroscopically detecting the contrast agent.

10 **21.** The method of claim 19, wherein advancing the tube through
the target site further comprises aligning the tube with the target site using an
imaging modality.

1/6

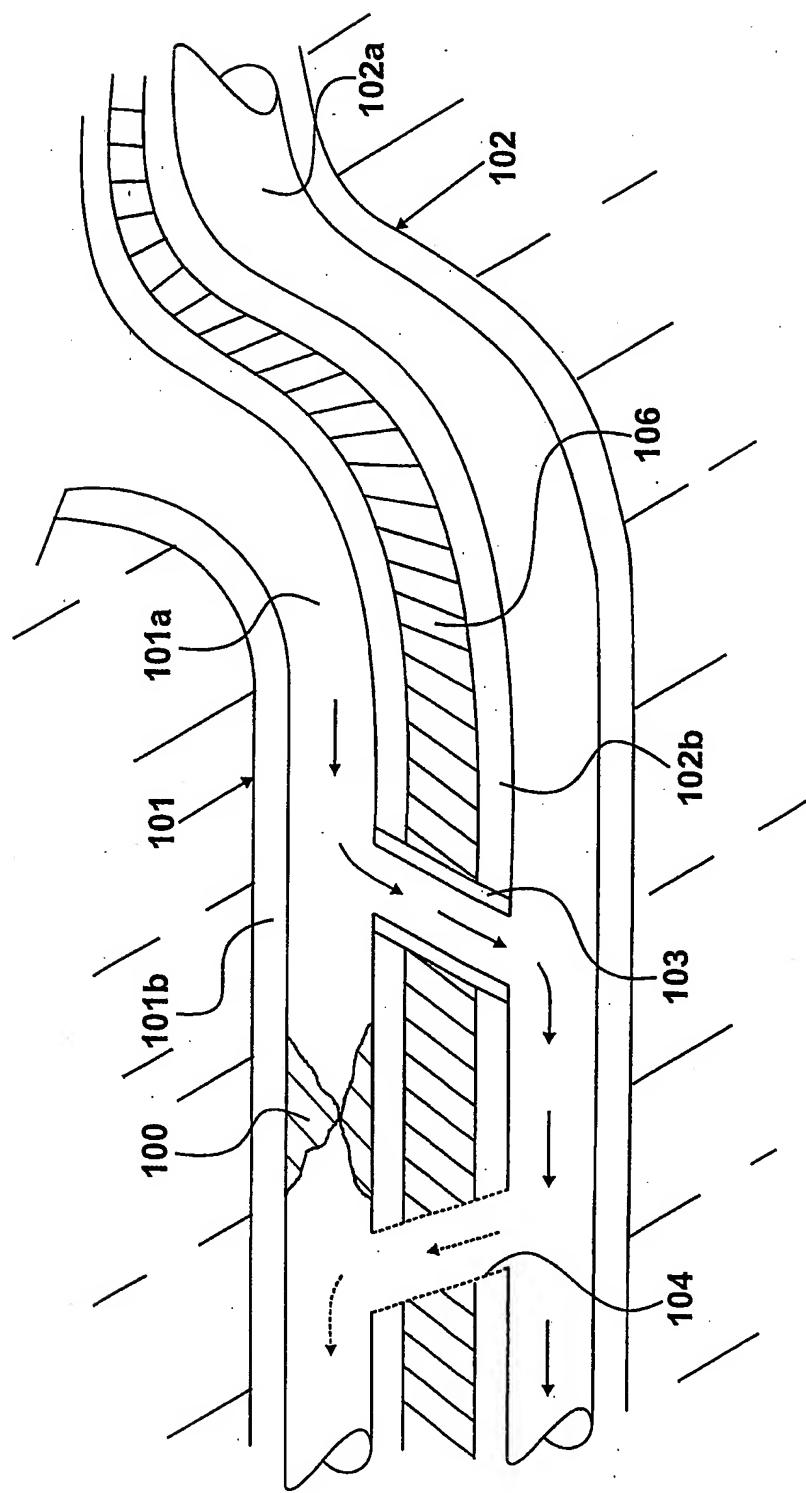


Figure 1

2/6

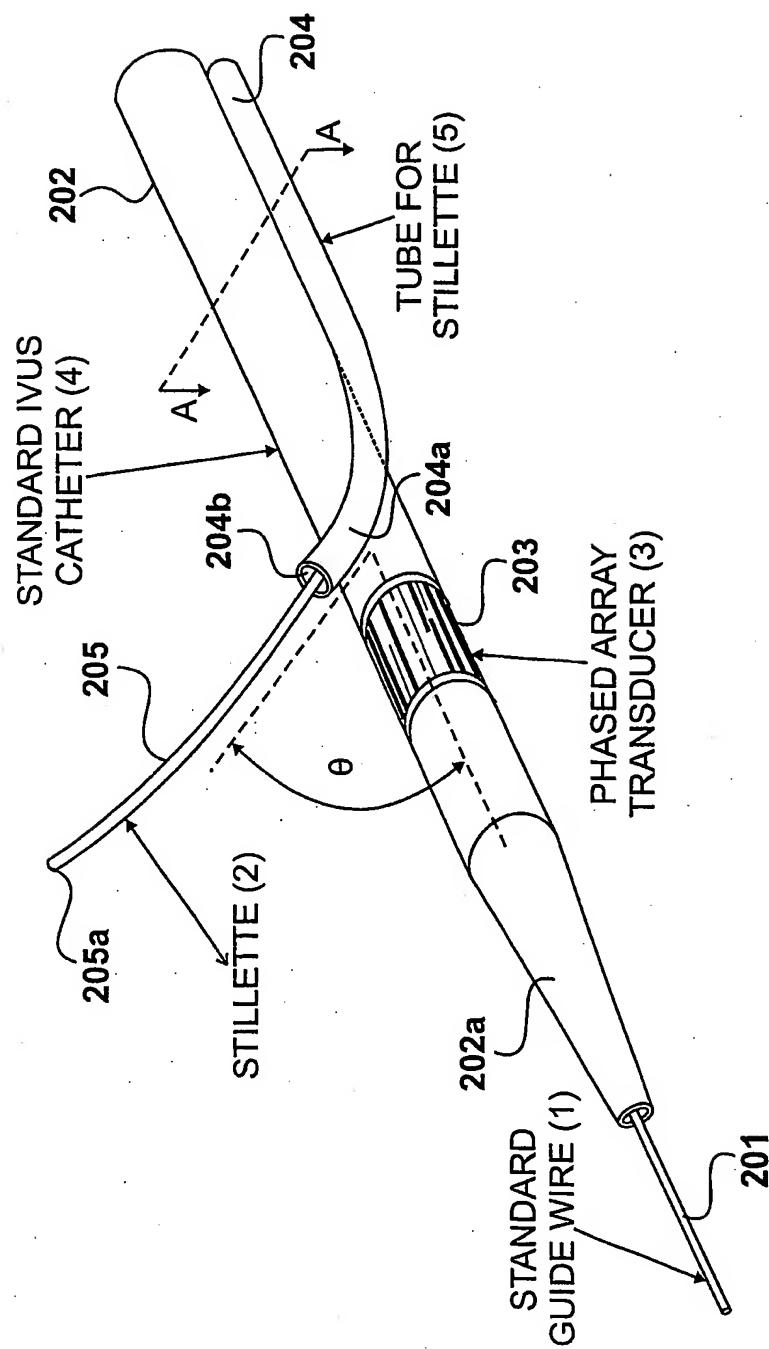


Figure 2

3/6

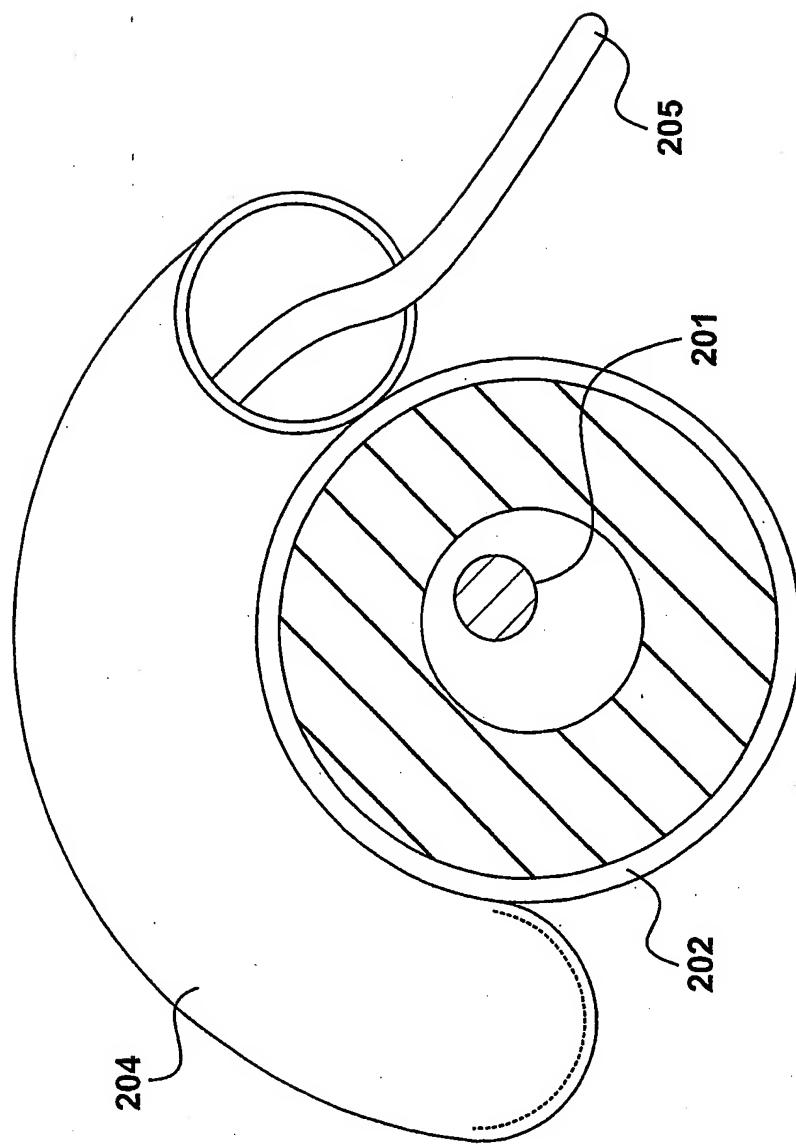


Figure 3

4/6

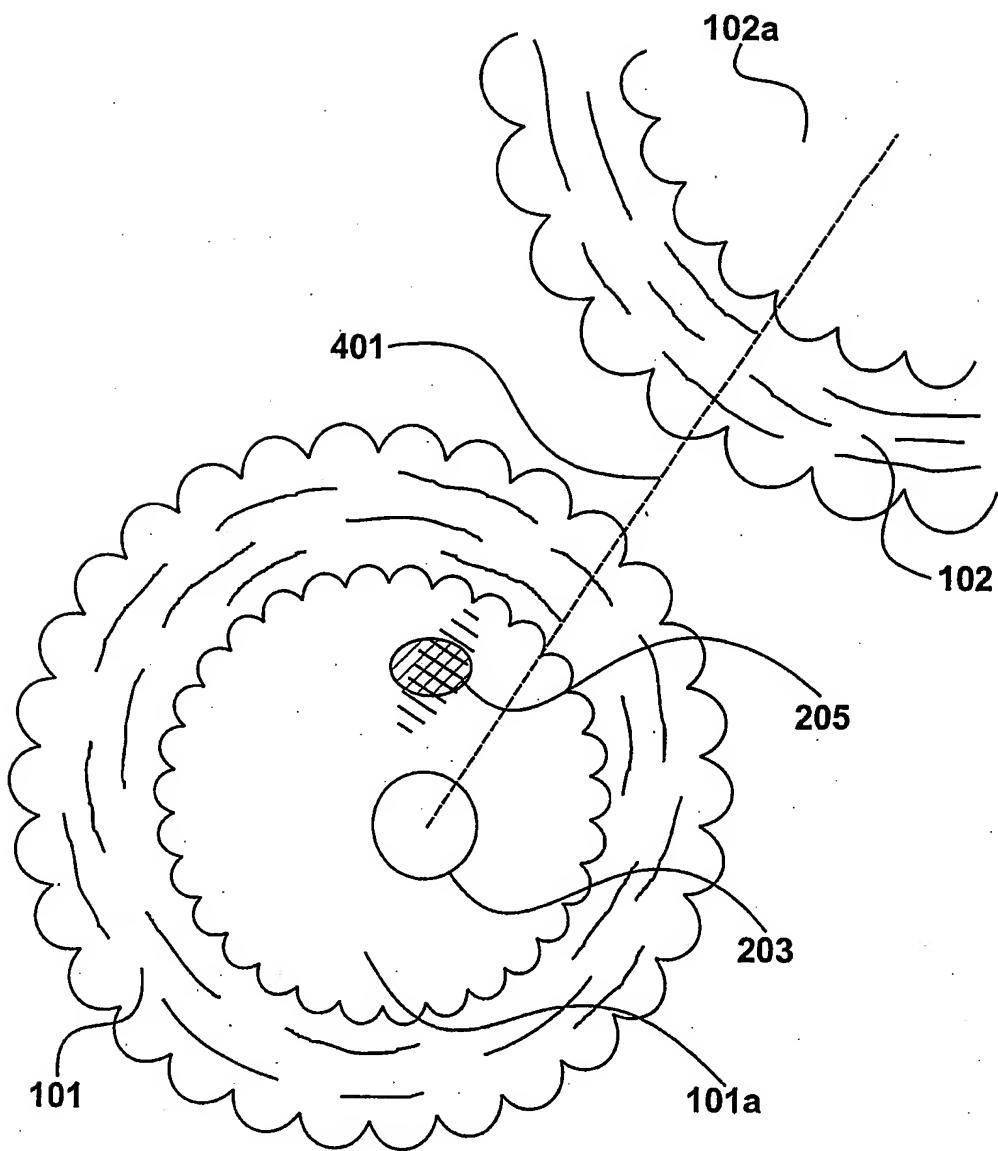


Figure 4

5/6

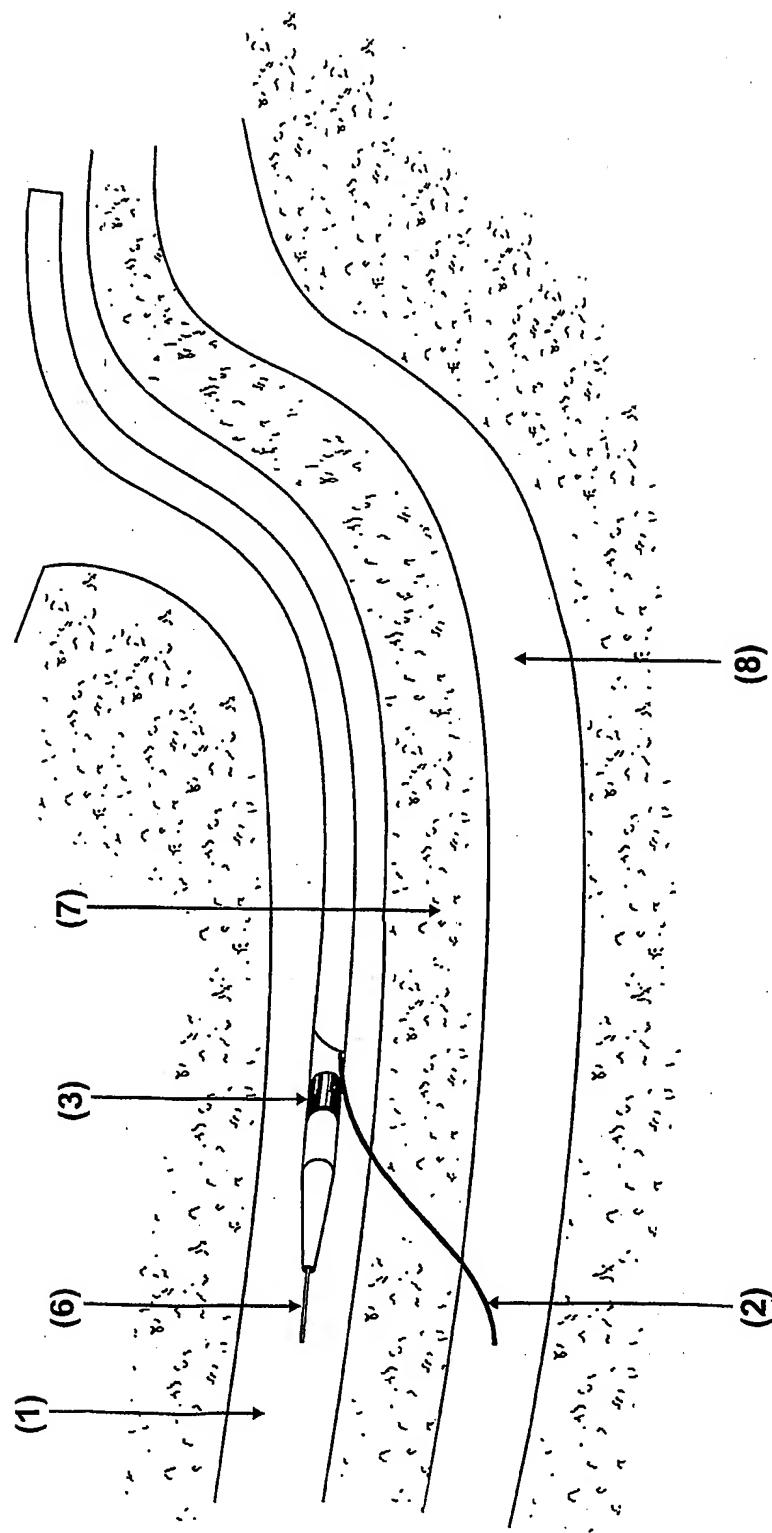


Figure 5

6/6

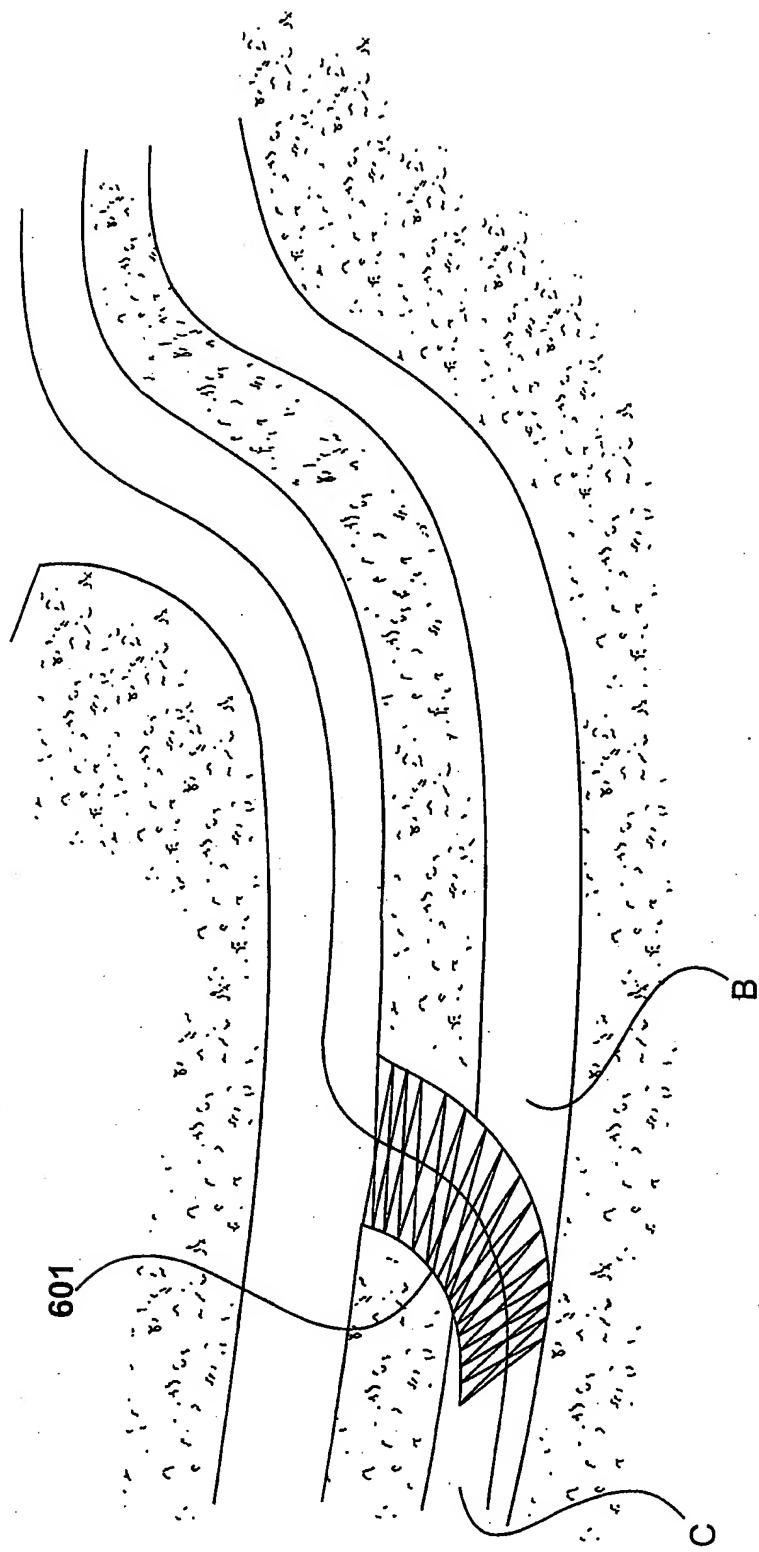


Figure 6

INTERNATIONAL SEARCH REPORT

Inr onal Application No
PCT/GB 01/04484

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B17/11

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01 70133 A (SOLEM JAN OTTO) 27 September 2001 (2001-09-27) abstract; claims 1-54; figures 1,6,21-56 ---	1-12
X	US 6 190 353 B1 (GARIBOTTO JOHN THOMAS ET AL) 20 February 2001 (2001-02-20) the whole document ---	1-12
X	WO 98 46119 A (TRANSVASCULAR INC ;MAKOWER JOSHUA (US)) 22 October 1998 (1998-10-22) abstract page 13, line 9 -page 14, line 34 page 40, line 19 -page 47, line 5; figures 1-5 ---	1-7,12

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the International filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the International filing date but later than the priority date claimed

- *T* later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the International search

19 December 2001

Date of mailing of the International search report

03/01/2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Hansen, S

INTERNATIONAL SEARCH REPORT

In:	International Application No
PCT/GB 01/04484	

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 35980 A (LUMEND INC ; MILO CHARLES F (US); VETTER JAMES W (US); HINOHARA TOM) 22 July 1999 (1999-07-22) abstract; figures 1-7 ---	1-7,12
X	US 6 293 955 B1 (WHAYNE JAMES G ET AL) 25 September 2001 (2001-09-25) the whole document ---	1-7,12
A	WO 99 49793 A (TRANSVASCULAR INC) 7 October 1999 (1999-10-07) abstract; figures 1-14 ---	1-12
A	US 6 035 856 A (EUTENEUER CHARLES L ET AL) 14 March 2000 (2000-03-14) abstract; figures 7-11 ---	1-12

INTERNATIONAL SEARCH REPORT

Int'l Application No
PCT/GB 01/04484

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 0170133	A	27-09-2001	WO 0170133 A2 SE 0000900 A	27-09-2001 21-09-2001
US 6190353	B1	20-02-2001	AU 1275997 A AU 733332 B2 AU 1847297 A AU 723785 B2 AU 1847397 A CA 2244079 A1 CA 2244080 A1 CN 1218414 A CN 1216929 A EP 0879068 A1 EP 0932426 A1 JP 2000504594 T JP 2000505316 T US 6283951 B1 WO 9816161 A1 WO 9727893 A1 WO 9727898 A1 US 6302875 B1 US 2001047165 A1 AU 726713 B2 AU 7431696 A AU 729466 B2 AU 7595396 A CA 2234361 A1 CA 2234389 A1 EP 0954248 A1 EP 0955933 A1 EP 0910298 A1 JP 11513577 T JP 11514269 T WO 9713471 A1 WO 9713463 A1 US 6068638 A US 6159225 A US 6283983 B1 US 6231587 B1 AU 733341 B2 AU 1847197 A CA 2244066 A1 CN 1216930 A JP 2001508318 T WO 9727897 A1	11-05-1998 10-05-2001 22-08-1997 07-09-2000 22-08-1997 07-08-1997 07-08-1997 02-06-1999 19-05-1999 25-11-1998 04-08-1999 18-04-2000 09-05-2000 04-09-2001 23-04-1998 07-08-1997 07-08-1997 16-10-2001 29-11-2001 16-11-2000 30-04-1997 01-02-2001 30-04-1997 17-04-1997 17-04-1997 10-11-1999 17-11-1999 28-04-1999 24-11-1999 07-12-1999 17-04-1997 17-04-1997 30-05-2000 12-12-2000 04-09-2001 15-05-2001 10-05-2001 22-08-1997 07-08-1997 19-05-1999 26-06-2001 07-08-1997
WO 9846119	A	22-10-1998	US 6302875 B1 AU 7358198 A EP 0964636 A1 WO 9846119 A1 US 2001047165 A1	16-10-2001 11-11-1998 22-12-1999 22-10-1998 29-11-2001
WO 9935980	A	22-07-1999	AU 2004999 A WO 9935980 A1	02-08-1999 22-07-1999
US 6293955	B1	25-09-2001	US 6149681 A US 5989276 A AU 721415 B2	21-11-2000 23-11-1999 06-07-2000

INTERNATIONAL SEARCH REPORT

Int'l Application No
PCT/GB 01/04484

Patent document cited in search report	Publication date		Patent family member(s)	Publication date
US 6293955	B1		AU 5355198 A EP 1011458 A2 JP 2001503657 T WO 9819625 A2 AU 4489197 A EP 1011524 A1 WO 9811847 A1	29-05-1998 28-06-2000 21-03-2001 14-05-1998 14-04-1998 28-06-2000 26-03-1998
WO 9949793	A	07-10-1999	AU 3459499 A AU 3547799 A EP 1067869 A2 EP 1067874 A1 WO 9949910 A2 WO 9949793 A1	18-10-1999 18-10-1999 17-01-2001 17-01-2001 07-10-1999 07-10-1999
US 6035856	A	14-03-2000	WO 9838939 A1	11-09-1998

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- BLACK BORDERS**
- IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- FADED TEXT OR DRAWING**
- BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- SKEWED/SLANTED IMAGES**
- COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- GRAY SCALE DOCUMENTS**
- LINES OR MARKS ON ORIGINAL DOCUMENT**
- REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.